

Modifying Production Systems to Reduce GHG Emissions – Two On-Farm Case Studies

Farmers seeking to reduce greenhouse gas (GHG) emissions have a number of options from which to choose. This infosheet outlines the most effective ones, and presents two real-life case studies and perspectives of Ontario farmers who've made transitions that lower GHG emissions and improve productivity, sustainability and safety in the long term.

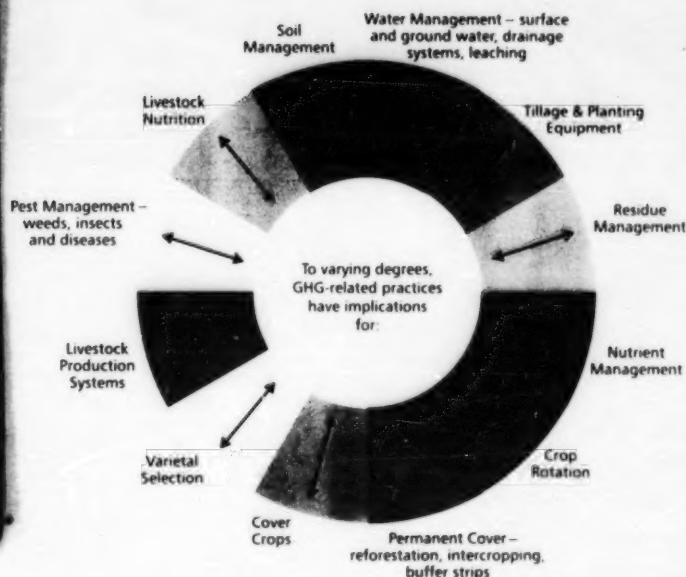
The process of making GHG-related changes is much like the adoption of other farm practices. Successful farmers know that a change in one area of their farm operation, such as cropping practices, has implications for other key features, such as soil type, nutrient requirements, and pest management. The same holds true for reducing GHG emissions.

That's why an **integrated systems approach** is the farmer's best strategy for cutting emissions.

Using less fertilizer on the farm will help lower nitrous oxide emissions. It may also necessitate adjustments to crop selection and aspects of nutrient management.

GLOSSARY

BMP	best management practice	N	nitrogen
C	carbon	N₂O	nitrous oxide
CO₂	carbon dioxide	NH₃	ammonia
CH₄	methane	NO₃	nitrate
GHGs	greenhouse gases	SOC	soil organic carbon



Adapted from the no-till wheel developed by Don Lobbs

To reduce GHG emissions:

Minimize N concentration in the soil over winter and during spring thaw.

- Tillage management** • adopt no-till practices
- Nutrient management** • eliminate or minimize tillage and eliminate fall and winter application of nutrients
– affected by soil texture (soil management)
– affects varietal selection, crop rotations, and pest and disease management



- Cover crops** • use live cover crops over winter to "trap" N
- Crop rotation** • include high N-requirement crops after legumes
– affects nutrient management



- Permanent cover** • create or encourage buffer strips along watercourses to take up excess N before it enters water



Time N availability to match crop requirements

- Nutrient management** • apply according to soil test and as crop requires additives
– can affect the fertilizer application equipment choices, and timing of operations
- include N credits from previous crops, manure, additives in calculations for crop requirements
– affects and is affected by cover crops, and crop rotations



To reduce GHG emissions (continued)

- can affect method and timing of applications, residue management, pest and disease management

Store and apply manure to minimize environmental impacts.

Manure management



- contain manure gases
- maximize nutrient availability in manure
 - can affect method and timing of application
- eliminate use of manure within minimum distance of stream
 - can affect nutrient management strategies in buffer areas
- other affected areas / activities include:
 - choice of equipment
 - crops that manure can be spread on
 - soil management

Increase carbon stock (sequestration).

Crop residues



- increase residue in soil and on surface
- reduce decomposition rate through adoption of no-till, changes in soil and residue management
 - affects equipment, crop rotation, nutrient and pest management, and application method for manure

Permanent vegetation



- **fragile lands** – reforest marginal areas or retire to permanent vegetation
- **streambanks** – enhance riparian areas with tree plantings, especially with high carbon-storing fibre species such as poplar
- **intercropping** – plant trees among crops
 - requires adjustments in crops, nutrient management, pest management, and possibly equipment

Minimize direct GHG emissions from livestock.

Livestock nutrition



- feed better balanced, higher digestibility diets to reduce fermentative gases (CO_2 , CH_4)
 - affects nutrient management
- use ionophores in ruminant diets to promote rumen efficiency, thereby reducing fermentative gases
 - affected by livestock production systems

Livestock production systems

- accelerate production systems (e.g., faster growth, shorter reproduction intervals)
 - affects livestock nutrition

On-farm GHG case studies

Most best management practices that focus on soil and water conservation have the added benefit of being good for greenhouse gas emission reduction. BMPs can be fine-tuned to further reduce GHGs without losing any of the soil and water benefits. If they are to be adopted, these adjustments must also benefit the producer economically (e.g., reduced nitrogen inputs).

Case Study #1 Cropland and GHGs



Co-operator
Bob Bedggood
Location:

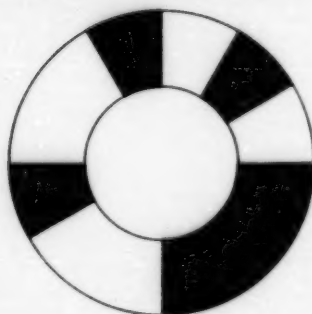
Thorndale, Middlesex County

Enterprise:

- operates a 350-acre family farm (owned plus rented)
- 400 sow farrow-to-finish operation
- dry manure system using straw bedding

Soils:

- clay to clay loam soils on flat topography, all systematically drained (Brantford/Bryanston/Teeswater/Walsher soil series)



BMP experience

- no-till and side-dressing have been used on the farm for 12 to 15 years

Soil and water BMPs currently in place that reduce GHGs:

- no-till wheat and beans with reduced-till corn in a corn-soybean-wheat/barley rotation
- nutrient management
 - side-dressing N on corn reduces N application rate by 10-15%
 - side-dressing is based on crop removal but not soil testing, and while it's done purely for economic savings, it has the added benefit of reducing excess N available to be released as N_2O
- manure applied twice per year, with more manure applied in spring than fall
- all manure incorporated
- windbreaks planted on northwest fencerows to block prevailing winds
- woodlots retained

Enhanced GHG BMPs in place:

- **buffer / riparian enhancement:**
 - 25 acres of trees planted along the creek flats, which divide the home farm in half
 - manure database values are used for crediting manure nutrients
- Awareness of GHG benefits to their operation:
- the Bedggoods were aware of the potential for fixing carbon (sequestration) with no-till and reducing N_2O emissions by side-dressing, but the primary reasons for choosing these BMPs were:
 - protection of soil from erosion

- enhancement of soil organic matter
- reduction of hours in field (fuel use and time reduced)
- economic sense
- personal reasons for implementing BMPs with GHG emission-reduction benefits included a strong stewardship ethic
- incentives that helped to implement BMPs included:
 - the availability of trees at an affordable rate from a local provincial nursery
 - program for planting and maintaining trees through the Upper Thames Conservation Authority

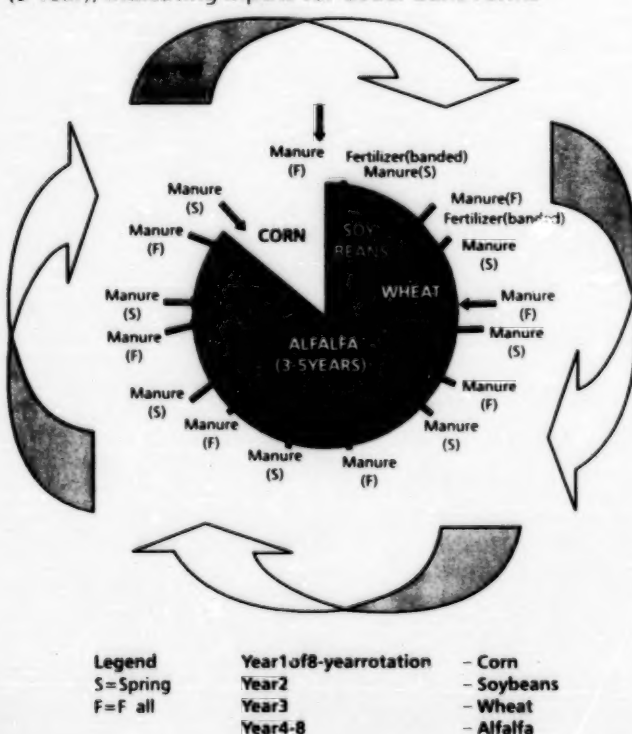
Challenges during transition:

- a yield depression in corn that was balanced by other benefits
- Additional benefits to this operation from introducing practices that reduce GHG emissions:
- excess soil NO_3 in late winter / early spring is reduced through use of no-till and reduced till
 - timing and method of commercial fertilizer (side-dressing) and manure (spring, incorporated) applications that match crop needs, reduce fertilizer requirements and minimize loss of excess fertilizer
 - future reductions in N fertilizer required over time, especially with regular soil testing and/or yield monitoring
 - riparian plantings intercept groundwater N leached from crops
 - added protection for and enhancement of watercourse, downstream benefits
 - windbreaks protect crops from prevailing northwest winds, and could provide long-term harvest

Agriculture could be a leader in balancing and/or reducing GHG emissions, thus encouraging the other sectors to address the GHG problem. Most producers would do more [in terms of environmental stewardship] if more money was available.

- Bob Bedgood

8-Year Rotation of Corn-Soybeans-Wheat-Alfalfa (5-Year), Indicating Inputs for Cedar Banc Farms



Case Study #2 Livestock and GHGs



Co-operator:

Bob McKinnon, Cedar Banc Farms Ltd.

Location:

Port Elgin, Bruce County

Enterprise:

- 100 dairy cows - liquid manure, 17 beef cow/calf - on pasture all the time
- 1800 acres farmed, 700 acres owned
- rotation: corn-soybean-wheat-alfalfa (stand in for min. 3 years and up to 5 if a healthy stand)
- other features of farm: 45 acres of hardwood woodlots on properties, marked and managed by Ministry of Natural Resources

Soils:

- relatively flat, tobacco sand (near lake) to heavy clay (inland), much of land alongside the Saugeen River (Brady/ Berrien/ Elderslie/ Fox/ Granby/ Saugeen/ Waterloo soils)

BMP experience

- began farming in 1974, started no-till in 1988, has been 100% no-till for 6-7 years, up to 2200 acres in '92-'94

Soil and water BMPs currently in place that benefit GHG reductions:

- soil test as part of OMAFRA site-specific N and deep N test plots
- banding all commercial fertilizer
 - get UAN 28% below seed and cut potash rates
- a 200-foot distance from river when spreading liquid manure on surface
 - no incorporation - no one has shown him that the cost of N loss justifies costs of incorporation and disturbing no-till soil benefits
- concrete manure pit holds 2 1/2 months, put in earthen lagoon 2 years ago which holds >365 days
 - wanted enough storage to be able to apply on wheat ground when dry
- windbreaks, buffer strips
- 100 acres of managed woodlot

Enhanced GHG BMPs in place:

- 100% no-till
- manure test every year

Awareness of GHG benefits to their operation:

- while producers are aware of the GHG benefits, this was not primary reason for implementation - economics was and is baseline
- protection of water quality
- safeguarding neighbourly relations by maintaining separation distances when spreading

Challenges during transition:

- trying to avoid compaction
 - can't "fix" compaction on no-till
 - penetrometer tests on rented land find depths of plough layer, and subsequent deep ripping alleviates compaction prior to no-till
- using GPS '93 and yield monitor '92 to do own test plots

Where to go for more information

Additional benefits to this operation from introducing practices that reduce GHG emissions:

- improved profitability
- reduced fertilizer use
- reduced conflict with neighbours through better communication regarding manure spreading

There are a number of BMPs that farmers can adopt to improve the soil, water and air quality of their farm operation, that simultaneously reduce GHG emissions. Possible examples include a range of proven standards along with newer, innovative methods: no-till, improved nutrient management, proper manure storage and handling and, use of ethanol-blended fuels. Not all methods are suitable for all soils and operations, and must be evaluated at the farm plot level prior to full-scale implementation. More basic and applied research is required to help the farmer choose and implement the BMPs that are most feasible and cost-effective for their land.

Future innovations in renewable feedstock products, like the replacement of petroleum-based chemicals with carbohydrate-based (corn) ones, will give society an even greater benefit from agriculture with GHG reductions included. Therefore, society has a responsibility to further the overall goal of GHG abatement through their support of the farming community by appropriate use of public funds for research and farm competitiveness at the global scale.

– Don McCabe, Lambton County farmer, currently Ont. Corn Producer Provincial Director for Lambton

This is the last of a four-part series that addresses greenhouse gas emissions and their implications for Ontario farmers. Infosheets #1, #2 and #3 address, respectively:

1. **greenhouse gases** – what they are, how they contribute to climate change, and what challenges and opportunities lie ahead for Ontario farmers
2. **carbon sequestration** – how agriculture contributes to carbon dioxide gas emissions, and which on-farm practices can reduce them by retaining or “sequestering” beneficial carbon as soil organic carbon
3. **nutrient management** – how good planning can reduce emissions.

All four are available at select locations, and accessible through the Ministry of Agriculture, Food and Rural Affairs web site at: www.gov.on.ca/OMAFRA/english/policy/Climate%20Change/Index.html

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The Greenhouse Gas infosheets are a project of the Ministry of Agriculture, Food and Rural Affairs.

For more information, call the Ministry of Agriculture, Food and Rural Affairs, Agricultural Information Contact Centre at 1-877-424-1300, or e-mail: ag.info@omafra.gov.on.ca

For farmers and rural landowners

Agriculture and Agri-Food Canada, 1998. “Health of Our Air: Towards sustainable agriculture in Canada”

- on the web at: www.agr.ca/research/branch

Best Management Practices series of books, including: *Farm Forestry and Habitat Management*, *Field Crop Production*, *No-till: Making it Work*, *Nutrient Management* and *Soil Management*

Publications of the Ministry of Agriculture, Food and Rural Affairs: *Agronomy Guide for Field Crops* (available late Fall 2001) *The Soil Fertility Handbook*

- available by calling 1-888-4-OMAFRA (1-888-466-2372) or e-mail your request to products@omafra.gov.on.ca or visit OMAFRA's web site at www.gov.on.ca/omafra

The Ontario Soil and Crop Improvement Association and the Ontario Innovative Farmers Association will also have information on cropping practices as they relate to GHG emission reduction.

Technical/scientific sources

Agriculture and Agri-Food Canada. “Reducing GHG Emissions from Canadian Agriculture.” Options Report, January 2000

Documentation of the Ontario Greenhouse Gas Emission sub-model (OGGEM). “A component of the GHG emission and economic model of Ontario.” May 2000

Soil Resources Group. “Ministry Management Practices and their Effect on GHG Emissions in the Ontario Agricultural Sector.” Final report for OMAFRA, 2000

Key web sites

Multimedia overviews of climate change, and links to GHG calculators
<http://www.climatechange.gc.ca>

Your link to OMAFRA's Climate Change resources
<http://www.gov.on.ca/OMAFRA/english/policy/Climate%20Change/Index.html>

Web site for National Climate Change Process. Available documents include: “Canada's First National Climate Change Business Plan,” and “Ontario – Air Quality and Climate Change: Insights, Opportunities and Solutions”
<http://www.nccp.ca>